
NT5D11 Line-side T1 Interface Card

Introduction

The NT5D11 Line-side T1 Interface Card is an intelligent peripheral equipment (IPE) line card that can be installed in either the NT8D37 IPE module (up to 8 cards), or the NT8D11 CE/PE module (up to 5 cards).

The line-side T1 card interfaces one T1 line, carrying 24 channels, to the Meridian 1 switch. This card occupies two card slots in the IPE shelf, utilizing 16 channels on slot 1 and 8 channels on slot 2. The line-side T1 card emulates an analog line card to the Meridian 1 system software; therefore, each channel is independently configurable by software control in the Single-line Telephone Administration program (LD10). The line-side T1 card also comes equipped with a Man-Machine Interface (MMI) maintenance program that provides diagnostic information regarding the status of the T1 link.

Physical description

The line-side T1 card mounts into any two consecutive IPE slots. The card consists of a motherboard and a daughterboard. The motherboard circuitry is contained on a standard 31.75 by 25.40 cm. (12.5 by 10.0 in.) printed circuit board. The daughterboard is contained on a 5.08 by 15.24 cm (2.0 by 6.0 in) printed circuit board and mounts to the motherboard on six standoffs.

Card connections

The line-side T1 card uses the NT8D81AA Tip and Ring cable to connect from the IPE backplane to the 25-pair amphenol connector on the IPE I/O input/output (I/O) panel. The I/O panel connector then connects directly to a T1 line, external alarm and an MMI terminal or modem using the NT5D13AA Line-side T1 I/O cable available from Northern Telecom.

Faceplate

The faceplate of the card is twice as wide as the other standard analog and digital line cards, thereby occupying two card slots. It comes equipped with four LED indicators. See [Figure 21](#).

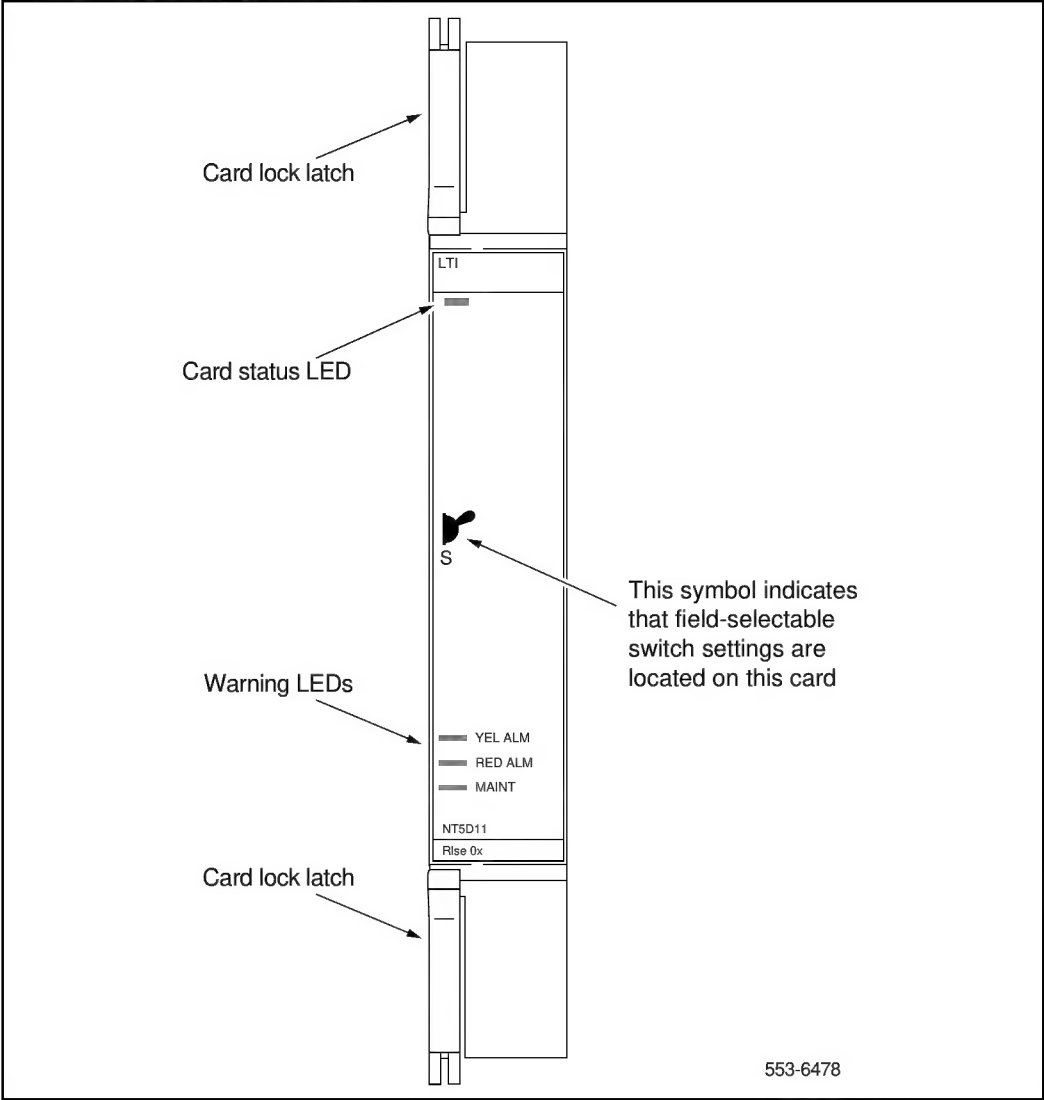
The LEDs give status indications on the operations as described in [Table 14](#).

Table 14
Line-side T1 card LED operation

LED	OPERATION
STATUS	Line card
RED ALARM	T1 near end
YELLOW ALARM	T1 far end
MAINT	Maintenance

The **STATUS** LED indicates that the line-side T1 card has successfully passed its self test, and therefore is functional. When the card is installed, this LED remains lit for two to five seconds as the self-test runs. If the self-test completes successfully, the LED flashes three times and remains lit until the card is configured and enabled in software, when the LED goes out. If the LED does not act as described or operates in any other manner (such as continually flashing or remaining weakly lit), the card should be replaced.

Figure 21
Line-side T1 card—faceplate



Note: Note: The STATUS LED indicates the enabled/disabled status of both card slots of the line-side T1 card simultaneously. To properly enable the card, both the motherboard and the daughterboard slots must be enabled. The STATUS LED will turn out as soon as either one of the line-side T1 card slots have been enabled. No LED operation will be observed when the second card slot is enabled. To properly disable the card, both card slots must be disabled. The LED will not turn on until both card slots have been disabled.

The **RED ALARM** LED indicates that the line-side T1 card has detected an alarm condition from the T1 link. Alarm conditions include, but are not limited to, such conditions as not receiving a signal or the signal has exceeded bit error thresholds or frame slip thresholds. (See [“Man-Machine T1 maintenance interface software” on page 109](#) for information on T1 link maintenance.)

If one of these alarm conditions is detected, this LED will light. Yellow alarm indication is sent to the far end as long as the near end remains in a red alarm condition. Depending on how the Man-Machine Interface (MMI) is configured, this LED will remain lit until the following actions occur:

- If the “Self-Clearing” function has been enabled in the MMI, the LED will clear the alarm when the alarm condition is no longer detected (this is the factory default condition).
- If the “Self-Clearing” function has *not* been enabled or it has been subsequently disabled in the MMI, the LED will stay lit until the command “Clear Alarm” has been typed in the MMI, even though the carrier automatically returned to service when the alarm condition was no longer detected.

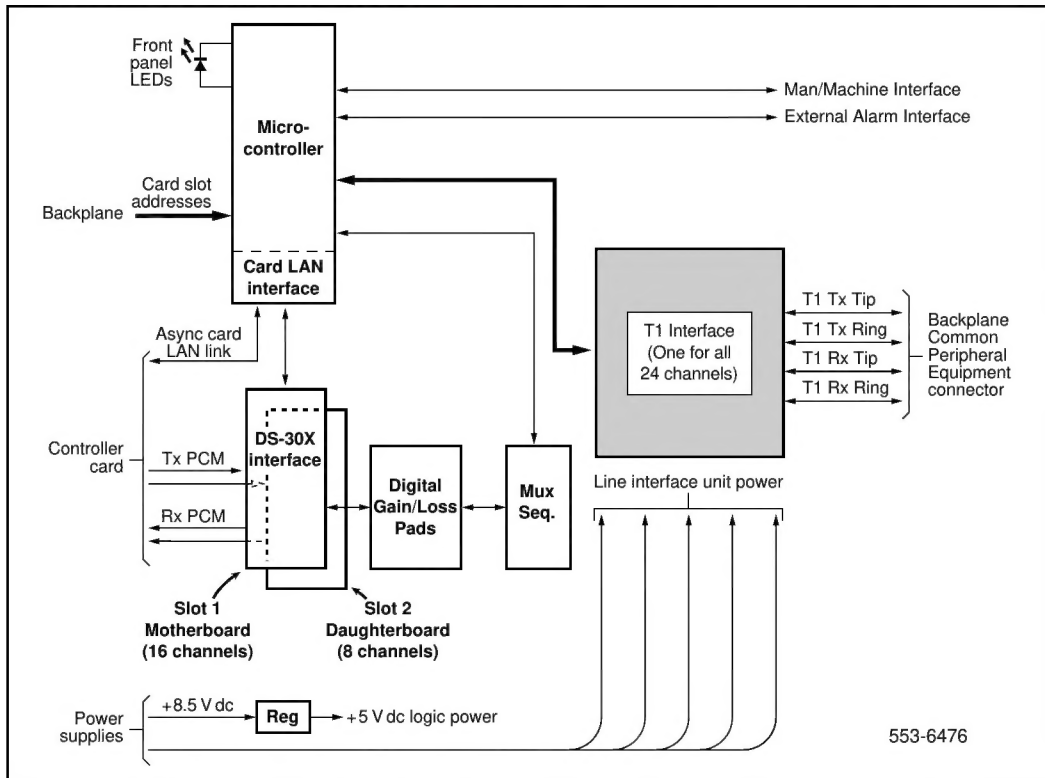
The **YELLOW ALARM** LED indicates that the line-side T1 card has detected a yellow alarm signal from the terminal equipment side of the T1 link. (See the [“Man-Machine T1 maintenance interface software” on page 109](#) for information on T1 link maintenance.) If the terminal equipment detects a red alarm condition (including, but not limited to, such conditions as not receiving a signal or the signal has exceeded bit error thresholds or frame slip thresholds), it may send a yellow alarm signal to the line-side T1 card, depending on whether or not your terminal equipment supports this feature. If a yellow alarm signal is detected, this LED will light.

The **MAINT** LED indicates whether the line-side T1 card is fully operational because of certain maintenance commands being issued through the MMI. (See [“Man-Machine T1 maintenance interface software” on page 109](#) for information on T1 link maintenance.) If the card detects that tests are being run or that alarms have been disabled through the MMI, this LED will light and will remain lit until these conditions are no longer detected, at which time it will turn off.

Functional description

Figure 22 shows a block diagram of the major functions contained on the line-side T1 card. Each of these functions is described on the following pages.

Figure 22
Line-side T1 card—block diagram



Overview

The line-side T1 card is an intelligent peripheral equipment (IPE) line card that provides a cost-effective all-digital connection between T1 compatible terminal equipment (such as voice mail systems, voice response units, trading turrets, etc.) and a Meridian 1 system. In this application the terminal equipment can be assured access to 2500 type line functionality such as hook flash, speed codes and ringback tones generated from the Meridian 1. In most cases, the line-side T1 card will eliminate the need for channel bank type equipment normally placed between the Meridian 1 and the terminal equipment, providing a more robust and reliable end-to-end connection. The line-side T1 card supports line supervision features such as loop and ground start protocols. It may also be used in an off-premise arrangement whereby 2500 type sets are extended over T1 with the use of channel bank equipment.

The line-side T1 interface offers significant improvement over the previous alternatives. For example, if a digital trunk connection were used, such as with the DTI/PRI interface card, line-side functionality would not be supported. Previously, the only way to achieve the line-side functionality was to use analog ports and channel bank equipment. With the line-side T1 interface, a direct connection is provided between the Meridian 1 and the peripheral equipment. No channel bank equipment is required, resulting in a more robust and reliable connection.

The line-side T1 interface offers a number of benefits when used to connect a Meridian 1 to third-party applications equipment. It is a more cost-effective alternative for connection because it eliminates the need for expensive channel bank equipment. In addition, the line-side T1 supports powerful T1 monitoring and diagnostic capability. Overall costs for customer applications may also be reduced because the T1-compatible peripheral equipment is often more attractively priced than the analog-port alternatives.

The line-side T1 card is compatible with all IPE based systems supported on X11 Release 17 and later software. The card is also compatible with standard public or private DSX-1 type carrier facilities. Using A/B robbed bit signaling, it supports D4 or ESF channel framing formats as well as AMI or B8ZS coding. Because it uses standard PCM in standard T1 timeslots, existing T1 test equipment remains compatible for diagnostic and fault isolation purposes.

Card interfaces

The line-side T1 card passes voice and signaling data over DS-30X loops through the DS-30X Interfaces circuits and maintenance data over the card LAN link. These interfaces are discussed in detail in “Intelligent peripheral equipment” on page 18.

T1 interface circuit

The line-side T1 card contains one T1 line interface circuit that provides 24 individually configurable voice interfaces to one T1 link in 24 different time slots. The circuit demultiplexes the 2.56 Mbps DS-30X Tx signaling bitstreams from the DS-30X network loop and converts it into 1.544 MHz T1 Tx signaling bitstreams onto the T1 link. It also does the opposite, receiving Rx signaling bitstreams from the T1 link and transmitting Rx signaling bitstreams onto the DS-30X network loop.

The line interface circuit performs the following:

- Provides an industry standard DSX-1 (0 to 655 feet) interface.
- Converts DS-30X signaling protocol into FXO A and B robbed bit signaling protocol.
- Provides switch-selectable transmission and reception of T1 signaling messages over a T1 link in either loop or ground start mode.

Signaling and control

The line-side T1 card also contains signaling and control circuits that establish, supervise, and take down call connections. These circuits work with the system controller to operate the T1 line interface circuit during calls. The circuits receive outgoing call signaling messages from the controller and return incoming call status information to the controller over the DS-30X network loop.

Card control functions

Control functions are provided by a microcontroller and a Card LAN link on the line-side T1 card. A sanity timer is provided to automatically reset the card if the microcontroller stops functioning for any reason.

Microcontrollers

The line-side T1 card contains two microcontrollers that control the internal operation of the card and the serial card LAN link to the controller card. The microcontrollers control the following:

- reporting to the CE CPU via the card LAN link:
 - card identification (card type, vintage, serial number)
 - firmware version
 - self-test results
 - programmed unit parameter status
- receipt and implementation of card configuration:
 - control of the T1 line interfaces
 - enabling/disabling of individual units or entire card
 - programming of loop interface control circuits for administration of channel operation
 - maintenance diagnostics
- interface with the line card circuit:
 - converts on/off-hook, and ringer control messages from the DS-30X loop into A/B bit manipulations for each time slot in the T1 data stream, using robbed bit signaling.
- the front panel LED when the card is enabled or disabled by instructions from the NT8D01 controller card.

Card LAN interface

Maintenance data is exchanged with the Common Equipment CPU over a dedicated asynchronous serial network called the Card LAN link. The Card LAN link is described in “Card LAN link” on page 21.

Sanity timer

The line-side T1 card also contains a sanity timer that resets the microcontroller in the event of a loss of program control. If the timer is not properly serviced by the microcontroller, it times out and causes the microcontroller to be hardware reset. If the microcontroller loses control and fails to service the sanity timer at least once per second, the sanity timer will automatically reset the microcontroller, restoring program control.

Man-Machine Interface (MMI)

The line-side T1 card provides an optional man-machine interface that is primarily used for T1 link performance monitoring and problem diagnosis. The MMI provides alarm notification, T1 link performance reporting and fault isolation testing. The interface is accessed through connections from the I/O panel to a terminal or modem. Multiple cards (up to 64) can be served through one MMI terminal or modem by cabling the cards together.

The MMI is an optional feature since all T1 configuration settings are performed through dip switch settings or preconfigured factory default settings. The man-machine interface is discussed fully in [“Man-Machine T1 maintenance interface software” on page 109.](#)

Electrical specifications

[Table 15](#) provides a technical summary of the T1 line interfaces, and [Table 16](#) lists the maximum power consumed by the card.

T1 channel specifications

[Table 15](#) provides specifications for the 24 T1 channels. Each characteristic is set by dip switches. See [“Installation and Configuration” on page 87](#) for the corresponding dip switch settings.

Table 15
Line-side T1 card—line interface unit electrical characteristics

Characteristics	Description
Framing	ESF or D4
Coding	AMI or B8ZS
Signaling	Loop or ground start A/B robbed-bit
Distance to CPE or Channel Service Unit	0-199.6 meters (0–655 feet)

Power requirements

The line-side T1 card requires +15 V, –15 V, and +5 V from the backplane. One NT8D06 Peripheral Equipment Power Supply AC or NT6D40 Peripheral Equipment Power Supply DC can supply power to a maximum of eight line-side T1 cards.

Table 16
Line-side T1 card—power required

Voltage	Current (max.)
+ 5.0 V dc	1.6 Amp
+15.0 V dc	150 mA.
–15.0 V dc	150 mA.

Foreign and surge voltage protections

In-circuit protection against power line crosses or lightning is not provided on the line-side T1 card. It does, however, have protection against accidental shorts to –52 V dc analog lines.

When the card is used to service off-premise terminal equipment through the public telephone network, install a channel service unit (CSU) as part of your terminal equipment to provide external line protection.

Environmental specifications

[Table 17](#) shows the environmental specifications of the line-side T1 card.

Table 17

Line-side T1 card—environmental specifications

Parameter	Specifications
Operating temperature-normal	15° to +30° C (+59° to 86°F), ambient
Operating temperature-short term	10° to +45° C (+50° to 113°F), ambient
Operating humidity-normal	20% to 55% RH (non-condensing)
Operating humidity-short term	20% to 80% RH (non-condensing)
Storage temperature	–50° to +70° C (–58° to 158°F), ambient
Storage humidity	5% to 95% RH (non-condensing)

Installation and Configuration

Installation and configuration of the line-side T1 card consists of six basic steps:

- 1** Configure the dip switches on the line-side T1 card for your environment.
- 2** Install the line-side T1 card into the selected card slots in the IPE shelf.
- 3** Cable from the I/O panel to the CPE or CSU, MMI terminal or modem (optional), external alarm (optional), and other line-side T1 cards for daisy chaining use of MMI terminal (optional).
- 4** Configure the MMI terminal.
- 5** Configure the line-side T1 card through the Meridian 1 software and verify self-test results.
- 6** Verify initial T1 operation and configure MMI (optional).

Steps 1-5 are explained in this section. Step 6 is covered in [“Man-Machine T1 maintenance interface software” on page 109](#).

Dip switch settings

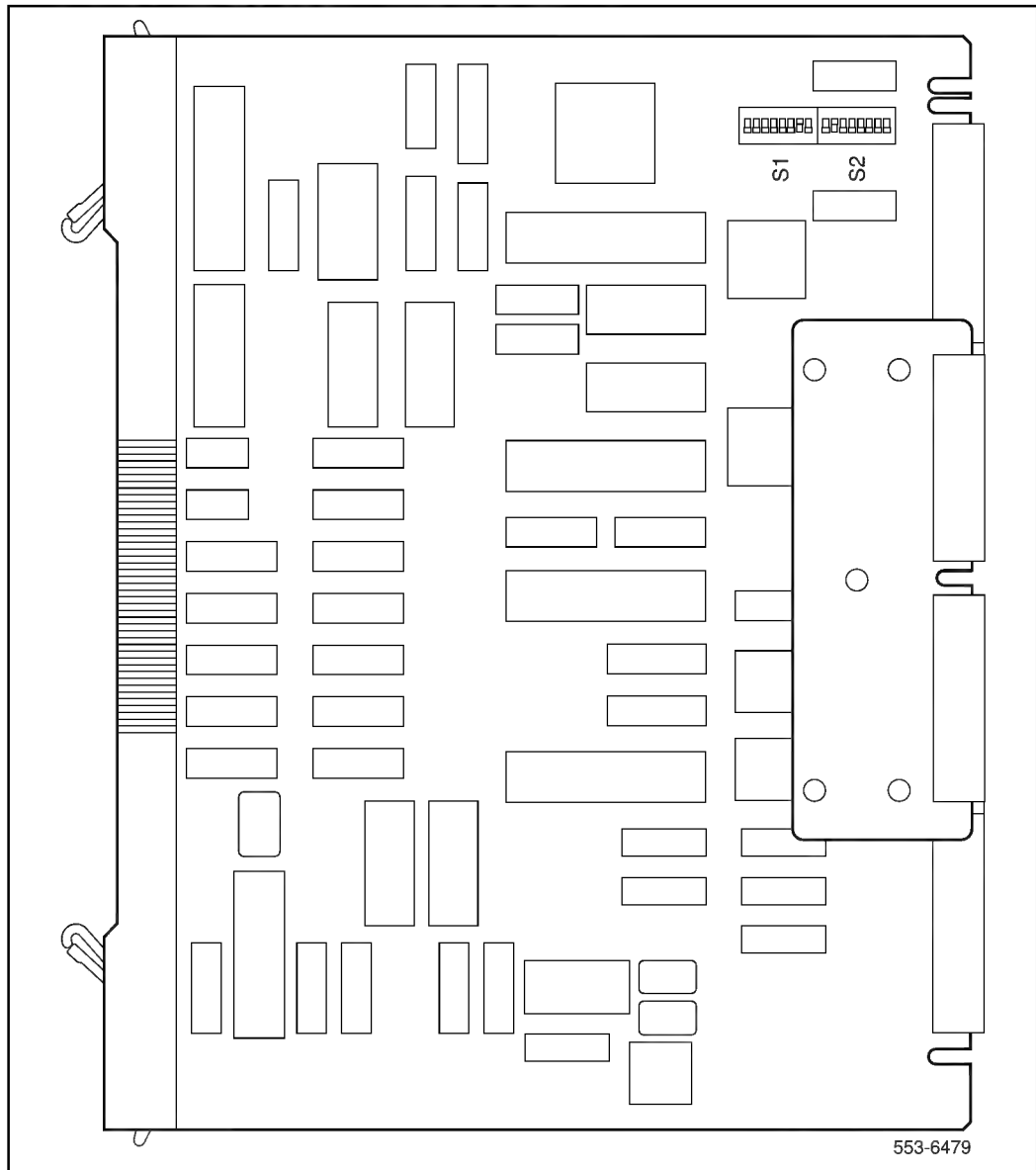
Begin your installation and configuration of the line-side T1 card by selecting the proper dip switch settings for your environment. The line-side T1 card contains two dip switches, each containing eight switch positions. They are located in the upper right corner of the motherboard circuit card as shown in [Figure 23](#). The settings for these switches are shown in [Tables 18](#) through [21](#).

When the line-side T1 card is oriented as shown in [Figure 23](#), the dip switches are ON when they are up, and OFF when they are down. The dip switch settings configure your card for the following parameters:

MMI port speed selection

This dip switch setting selects the appropriate baud rate for the terminal or modem (if any) that is connected to your MMI.

Figure 23
Line-side T1 card—T1 protocol dip switch locations



Line Supervisory Signaling protocol

As described in “Line-side T1 call operation” on page 40, the line-side T1 card is capable of supporting loop start or ground start call processing modes. Make your selection for this dip switch position based on what type of line signaling your CPE equipment supports.

Address of line-side T1 card to the MMI

The address of the line-side T1 card to the MMI is made up of two components:

- 1** The address of the card within the shelf
- 2** The address of the shelf in which the card resides

These two addresses are combined create a unique address for the card. The MMI reads the address of the card within the shelf from the card firmware; however the address of the shelf must be set by this dip switch.

The shelf address dip switch can be from 0-15, 16 being the maximum number of line-side T1 IPE shelves (a maximum of 64 line-side T1 cards) capable of daisy chaining to a single MMI terminal. For clarity and ease, it is recommended that this address be set the same as the address of the peripheral controller identifier in overlay 97 for type: XPE. However, this is not mandatory, and, since the dip switch is limited to 16, this will not always be possible.

T1 framing

The line-side T1 card is capable of interfacing with CPE or CSU equipment either in D4 or ESF framing mode. Make your selection for this dip switch position based on what type of framing your CPE or CSU equipment supports.

T1 Coding

The line-side T1 card is capable of interfacing with CPE or CSU equipment using either AMI or B8ZS coding. Make your selection for this dip switch position based on what type of coding your CPE or CSU equipment supports.

DSX-1 length

Estimate the distance between the line-side T1 card and the hardwired local CPE or the Telco demarc RJ48 for the carrier facility connecting the line-side T1 and the remote CPE. Make your selection for this dip switch position based on this distance.

Line supervision on T1 failure

This setting determines in what state all 24 ports of the line-side T1 card will appear to the Meridian 1 in case of T1 failure. Ports can appear to the Meridian 1 as either in the on-hook or off-hook states on T1 failure.

Note: All idle line-side T1 lines will go off-hook and seize a Digitone Receiver when the off-hook line processing is invoked on T1 failure. This may prevent DID trunks from receiving incoming calls until the line-side T1 lines time-out and release the DTRs.

Daisy-Chaining to MMI

If you plan to install two or more line-side T1 cards and you plan to use the MMI, you will want to daisy-chain your cards together to use one MMI terminal or modem (see [Figure 25](#)). Make your selection for this dip switch position based on how many line-side T1 cards you are installing.

MMI Master or Slave

This setting is used only if you are daisy-chaining your cards to the MMI terminal or modem. It determines whether this card is a master or a slave in your MMI daisy-chain. Select the master setting if this card is the card that is cabled directly into the MMI terminal or modem; select the slave setting if this card is cabled to another line-side T1 card in a daisy chain.

[Tables 18](#) through [21](#) describe the proper dip switch settings for each type of T1 link. After the card has been installed, the MMI will display the DIP switch settings by using the command **Display Configuration**. See [“Man-Machine T1 maintenance interface software” on page 109](#) for details on how to invoke this command.

Table 18
Line-side T1 card—T1 Switch 1 (S1) dip switch settings

Dip Switch Number	Characteristic	Selection
1	MMI port speed selection	On = 1200 baud Off = 2400 baud
2	T1 signaling	On = Ground start Off = Loop start
3–6	XPEC Address for the line-side T1 card	See Table 19
7	Not Used	Leave Off
8	Reserved for SL-100 use	Leave Off

Table 19
Line-side T1 card—XPEC address dip switch settings (Switch S1, positions 3–6)

XPEC Address	S1 Switch Position 3	S1 Switch Position 4	S1 Switch Position 5	S1 Switch Position 6
00	Off	Off	Off	Off
01	Off	Off	Off	On
02	Off	Off	On	Off
03	Off	Off	On	On
04	Off	On	Off	Off
05	Off	On	Off	On
06	Off	On	On	Off
07	Off	On	On	On
08	On	Off	Off	Off
09	On	Off	Off	On
10	On	Off	On	Off
11	On	Off	On	On
12	On	On	Off	Off
13	On	On	Off	On
14	On	On	On	Off
15	On	On	On	On

Table 20
Line-side T1 card—T1 Switch 2 (S2) dip switch settings

Dip Switch Number	Characteristic	Selection
1	T1 framing	On = D4 Off = ESF
2	T1 Coding	On = AMI Off = B8ZS
3–5	CPE or CSU distance	See Table 21
6	Line processing on T1 link failure	On = On-hook Off = Off-hook
7	Daisy-chaining to MMI	On = Yes Off = No
8	MMI Master or Slave	On = Master Off = Slave

Table 21
Line-side T1 card—CPE or CSU distance dip switch settings (Switch S2, positions 3–5)

Distance	S2 Switch Position 3	S2 Switch Position 4	S2 Switch Position 5
0–133	On	Off	Off
134–266	Off	On	On
267–399	Off	On	Off
400–533	Off	Off	On
534–655	Off	Off	Off

Installation

This section describes how to install and test the line-side T1 card. For more specific installation instructions for circuit cards in general, see *Circuit card installation and testing* (553-3001-211).

When installed, the line-side T1 card occupies two card slots. It can be installed into either an NT8D11 Common/Peripheral Equipment (CE/PE) Module or an NT8D37 Intelligent Peripheral Equipment (IPE) Module.

When you are installing the line-side T1 card into the NT8D11 CE/PE or NT8D37 IPE module, you must determine which vintage level module you have. If the 25-pair I/O connectors are partially split between adjacent IPE card slots, the line-side T1 card works only in card slots where Unit 0 of the motherboard card slot appears on the first pair of the 25-pair I/O connector.

Certain vintage levels have dedicated 25-pair I/O connectors only for card slots 0, 4, 8, and 12. These vintage levels are cabled with only 16 pairs of wires from each card slot to the I/O panel. Some of the 25-pair I/O connectors are split between adjacent card slots. Other vintage levels cable each card slot to the I/O panel using a unique, 24-pair connector on the I/O panel. In these vintage levels, the line-side T1 card can be installed in any available pair of card slots. However, because of the lower number of wire pairs cabled to the I/O panel in the lower vintage level, only certain card slots are available to the line-side T1 card.

See [Table 22](#) for the vintage level information for the NT8D11 CE/PE modules and [Table 23](#) for the vintage level information for the NT8D37 IPE modules.

Table 22
Line-side T1 card—NT8D11 CE/PE Module vintage level port cabling

Vintage Level	Number of ports cabled to I/O panel
NT8D11AC	16 ports
NT8D11BC	24 ports
NT8D11DC	16 ports
NT8D11EC	24 ports

Table 23
Line-side T1 card—NT8D37 IPE Module vintage level port cabling

Vintage Level	Number of ports cabled to I/O panel
NT8D37AA	16 ports
NT8D37BA	24 ports
NT8D37DC	16 ports
NT8D37DE	16 ports
NT8D37EC	24 ports

Available and restricted card slots in the NT8D11 CE/PE Module

If you are installing the line-side T1 card into an NT8D11 CE/PE Module, the card slots available depend on what vintage level module you have.

Vintage levels cabling 24 ports For modules with vintage levels that cabled 24 ports to the I/O panel, the line-side T1 card can be installed in any pair of card slots 0–9.

Vintage levels cabling 16 ports For modules with vintage levels that cabled 16 ports to the I/O panel, you can install the line-side T1 card into the following card slot pairs:

Available:	Motherboard/Daughterboard
	0 and 1
	1 and 2
	4 and 5
	7 and 8

You cannot install the line-side T1 card into the following card slot pairs:

Restricted:	Motherboard/Daughterboard
	2 and 3
	3 and 4
	5 and 6
	6 and 7
	8 and 9

If you must install the line-side T1 card into one of the restricted card slot pairs, you can rewire your IPE module card slot to the I/O panel by installing an additional NT8D81 cable from the line-side T1 card motherboard slot to the I/O panel and re-arranging the three backplane connectors for the affected card slots. This will permit the connection of the NT5D13AA Line-side T1 card carrier and maintenance external I/O cable at the IPE and CE/PE module I/O panel connector for card slots that are otherwise restricted.

Alternatively, all line-side T1 card connections can be made at the main distribution frame instead of connecting the NT5D13 Line-side T1 card external I/O cable at the I/O panel. This eliminates these card slots restrictions.

Available and restricted card slots in the NT8D37 IPE Module

If you are installing the line-side T1 card into an NT8D37 IPE Module, the card slots available depend on what vintage level module you have.

Vintage levels cabling 24 ports For modules with vintage levels that cabled 24 ports to the I/O panel, the line-side T1 card can be installed in any pair of card slots 015.

Vintage levels cabling 16 ports For modules with vintage levels that cabled 16 ports to the I/O panel, you can install the line-side T1 card into the following card slot pairs:

Available:	Motherboard/Daughterboard
	0 and 1
	1 and 2
	4 and 5
	7 and 8
	8 and 9
	9 and 10
	12 and 13
	13 and 14

You cannot install the line-side T1 card into the following card slot pairs:

Restricted:	Motherboard/Daughterboard
	2 and 3
	3 and 4
	6 and 7
	10 and 11
	11 and 12
	14 and 15

If you must install the line-side T1 card into one of the restricted card slot pairs, you can rewire your IPE module card slot to the I/O panel by installing an additional NT8D81 cable from the line-side T1 card motherboard slot to the I/O panel, and re-arranging the three backplane connectors for the affected card slots. This will permit the connection of the NT5D13AA Line-side T1 card carrier and maintenance external I/O cable at the IPE and CE/PE module I/O panel connector for card slots that are otherwise restricted.

Alternatively, all line-side T1 card connections can be made at the main distribution frame instead of connecting the NT5D13 Line-side T1 card external I/O cable at the I/O panel. This eliminates these card slots restrictions.

Cabling the line-side T1 card

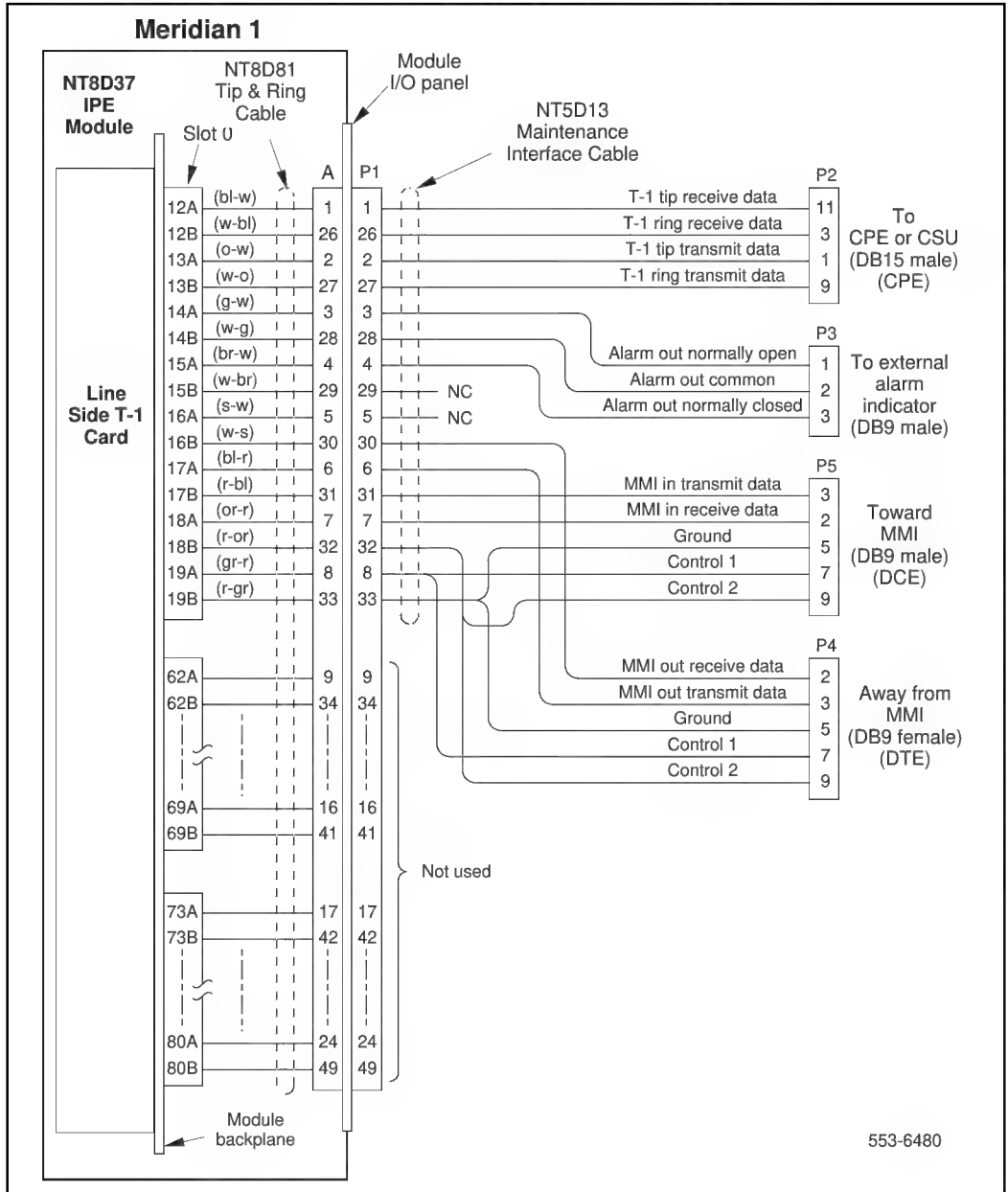
After you have set the dip switches and installed the line-side T1 card into the selected card slots, you are ready to cable the line-side T1 card to the CPE or CSU equipment. You can also make connections to the MMI terminal or modem (optional), an external alarm (optional), and other line-side T1 cards for daisy-chain use of the MMI terminal (optional).

The line-side T1 card is cabled from its backplane connector through connections from the motherboard circuit card only (no cable connections are made from the daughterboard circuit card) to the input/output (I/O) panel on the rear of the IPE module. The connections from the line-side T1 card to the I/O panel are made with the NT8D81AA Tip and Ring cables provided with the IPE module.

Cabling from the I/O panel with the NT5D13AA Line-side T1 I/O cable

Normally you will make the connection from the I/O panel to the T1 link and other external devices through the NT5D13AA Line-side T1 I/O cable (see [Figure 24](#)). This cable consists of a 25-pair amphenol connector (P1) on one end which plugs into the I/O panel. The other end has 4 connectors: a DB15 male connector (P2) which plugs into the T1 line, a DB9 male connector (P3) which plugs into an external alarm system, a second DB9 male connector (P5) which connects to an MMI terminal or modem, and a DB9 female connector (P4) that connects to the next line-side T1 card's P4 connector for MMI daisy chaining.

Figure 24
Line-side T1 card—connection using the NT5D13AA Line-side T1 Cable



Cabling from the I/O panel at the Main Distribution Frame

You may also choose to make all line-side T1 connections at the main distribution frame (MDF) if you prefer not to use the NT5D13AA Line-side T1 I/O cable at the I/O panel. To make the connections at the MDF, follow this procedure:

- 1 Punch down the first eight pairs of a standard telco 25-pair female-connectorized cross-connect tail starting with the first tip and ring pair of the line-side T1 motherboard card slot on the cross-connect side of the MDF terminals.
- 2 Plug the NT5D13AA Line-side T1 I/O cable into this 25-pair cross-connect tail at the MDF, regardless of the card slot restrictions that exist from the vintage level of IPE or CE/PE module you have. You can also make this connection at the MDF without using the NT5D13 Line-side T1 I/O cable, by cross-connecting according to the pinouts in [Table 24](#).
- 3 Turn over the T1 transmit and receive pairs, where required for hardwiring the line-side T1 card to local CPE T1 terminal equipment.

The backplane connector is arranged as an 80-row by 2-column array of pins. [Table 24](#) shows the I/O pin designations for the backplane connector and the 25-pair Amphenol connector from the I/O panel. Although the connections from the I/O panel only use 14 of the available 50 pins, the remaining pins are reserved and cannot be used for other signaling transmissions.

The information in [Table 24](#) is provided as a reference and diagnostic aid at the backplane, since the cabling arrangement may vary at the I/O panel. See *Meridian 1 system installation procedures* (553-3001-210) for cable pinout information for the I/O panel.

[Table 25](#) shows the pin assignments when using the NT5D13AA Line-side T1 I/O cable.

Table 24
Line-side T1 card—backplane pinouts

Backplane Connector Pin	I/O Panel Connector Pin	Signal
12A	1	T1 Tip, Receive Data
12B	26	T1 Ring, Receive Data
13A	2	T1 Tip, Transmit Data
13B	27	T1 Ring, Transmit Data
14A	3	Alarm out, Normally open
14B	28	Alarm out, Common
15A	4	Alarm out, Normally closed
15B	29	No Connection
16A	5	No Connection
16B	30	Away from MMI terminal, Receive Data
17A	6	Away from MMI terminal, Transmit Data
17B	31	Towards MMI terminal, Transmit Data
18A	7	Towards MMI terminal, Receive Data
18B	32	Daisy-chain Control 2
19A	8	Daisy-chain Control 1
19B	33	Ground

Table 25
Line-side T1 card—NT5D13AA Connector pinouts

I/O Panel Connector Pin	Lead Designations	NT5D13AA Line-side T1 I/O Connector Pin	Line-side T1 cable connector to external equipment
1	T1 Tip Receive Data	11	DB15 male to T1 (P2) Line-side T1 card is CPE transmit to network and receive from network
26	T1 Ring Receive Data	3	
2	T1 Tip Transmit Data	1	
27	T1 Ring Transmit Data	9	
3	Alarm out common	1	DB9 male to external alarm (P3)
28	Alarm out (normally open)	2	
4	Alarm out (normally closed)	3	
7	Towards MMI terminal Receive Data	2	DB9 male towards MMI (P5) Wired as DCE Data is transmitted on pin 2 (RXD) and received on pin 3 (TXD)
31	Towards MMI terminal Transmit Data	3	
33	Ground	5	
8	Control 1	7	
32	Control 2	9	
33	Ground	5	DB9 female away from MMI (P4) Wired as DTE Data is transmitted on pin 2 (TXD) and received on pin 3 (RXD)
8	Control 1	7	
32	Control 2	9	
30	Away from MMI terminal Transmit Data	3	
6	Away from MMI terminal Receive Data	2	

T1 connections

T1 signaling for all 24 channels is transmitted over P2 connector pins 1, 3, 9, and 11 as shown in [Table 25](#). Plug the DB15 male connector labeled “P2” into the T1 link. T1 transmit and receive pairs must be turned over between the line-side T1 card and CPE equipment that is hardwired without carrier facilities. If the line-side T1 card is connected via T1 carrier facilities, the transmit and receive pairs must be wired straight through to the RJ48 at the Telco demarc, the CSU, or other T1 carrier equipment. The T1 CPE equipment at the far end will likewise have transmit and receive wired straight from the RJ48 demarc at the far end of the carrier facility.

External alarm connections

P3 connector pins 3, 4, and 28 can be plugged into any external alarm hardware. Plug the male DB9 connector labeled “P3” into the external alarm. These connections are optional, and the functionality of the line-side T1 card is not affected if they are not made.

The MMI (described in detail in [“Man-Machine T1 maintenance interface software” on page 109](#)) monitors the T1 link for specified performance criteria and reports on problems detected. One of the ways it can report information is through this external alarm connection. If connected, the line-side T1 card’s microprocessor activates the external alarm hardware if it detects certain T1 link problems that it has classified as alarm levels 1 or 2. (See [“Man-Machine T1 maintenance interface software” on page 109](#) for a detailed description of alarm levels and configuration.) If an alarm level 1 or 2 is detected by MMI, the line-side T1 card will close the contact that is normally open, and will open the contact that is normally closed. The MMI command **Clear Alarm** will return the alarm contacts to their normal state.

MMI connections

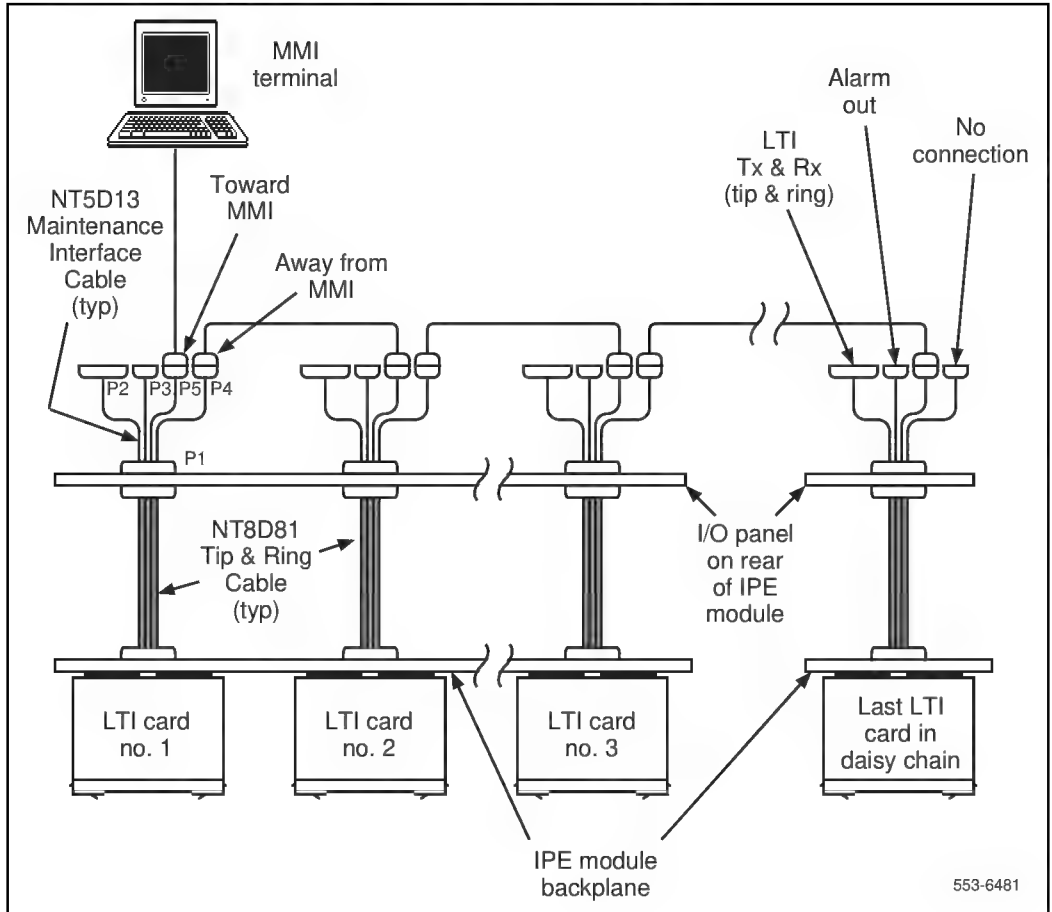
P5 connector pins 2, 3, 5, 7 and 9 are used to connect the line-side T1 card to the MMI terminal and daisy chain line-side T1 cards together for access to a shared MMI terminal. When you log into a line-side T1 card, “control 2” is asserted by that card, which informs all of the other cards not to talk on the bus, but rather to pass the data straight through. The pins labeled “control 1” are reserved for future use. As with the external alarm connections, MMI connections are optional. You can link up to 128 line-side T1 cards, located in up to 16 separate IPE shelves, to one MMI terminal using the daisy chaining approach.

If you are installing only **one** line-side T1 card, cable from the DB9 female connector labeled “P5” (towards MMI terminal) to one of the COM ports on the back of any TTY, a PC running a terminal emulation program, or a modem. For installations of only one card, no connection is made to the DB9 male connector labeled “P4” (away from MMI terminal).

If you are installing **two or more** line-side T1 cards into your Meridian 1 system, you can daisy-chain the MMI port connections together so that only one MMI terminal is required for up to 128 line-side T1 cards (as shown in [Figure 25](#)). Cards can be located in up to 16 separate IPE shelves. You can start with any card slot in your IPE shelf and connect to any other card slot; the card slots connected together do not need to be consecutive. Follow this procedure for connecting two or more line-side T1 cards to the MMI terminal:

- 1 Cable the DB9 male connector labeled “P5” (towards MMI terminal) to one of the COM ports on the back of any TTY, a PC running a terminal emulation program, or a modem.
- 2 Make the connection from the first card to the second card by plugging the DB9 female connector labeled “P4” (away from MMI terminal) from the *first* card into the DB9 male connector of the second card labeled “P5” (towards MMI terminal).
- 3 Repeat Step 2 for the remaining cards.
- 4 When you get to the last card in your daisy chain, make no connection to the DB9 male connector labeled “P4” (away from MMI terminal).
- 5 If two line-side T1 cards are located too far apart to connect the “P4” and “P5” connectors together, connect them together with an off-the-shelf DB-9 female to DB-9 male straight through extension cable, available at any PC supply store.

Figure 25
Line-side T1 card—connecting two or more cards to the MMI



Terminal configuration

For the MMI terminal to be able to communicate to the line-side T1 card, the interface characteristics must be set to:

- Speed—1200 or 2400 bps, depending on the setting of switch position 1 of Switch 1
- Character width—8 bits
- Parity bit—none
- Stop bits—one
- Software handshake (XON/XOFF) off

Software configuration

Although much of the architecture and many of the features of the line-side T1 card are different from the analog line card, the line-side T1 card has been designed to emulate an analog line card to the Meridian 1 software. Because of this, the line-side T1 card software configuration is performed the same as an two adjacent analog line cards.

All 24 T1 channels carried by the line-side T1 card are individually configured using the Single-line Telephone Administration program (LD 10). Use [Table 26](#) to determine the correct unit number and the *X11 input/output guide* (553-3001-400) for LD 10 service change instructions.

The line-side T1 card circuitry routes 16 units (0-15) on the motherboard and eight (0-7) units on the daughterboard to 24 T1 channels. The motherboard circuit card is located in the left card slot, and the daughterboard circuit card is located in right card slot. For example, if you were to install the line-side T1 card into card slots 0 and 1, the motherboard would reside in card slot 0 and the daughterboard would reside in card slot 1. In order to configure the terminal equipment through the switch software, you will need to be able to cross-reference the T1 channel number to the corresponding card unit number. This mapping is shown in [Table 26](#).

Table 26
DX-30 to T1 time slot mapping

TN		T1 Channel Number
Motherboard	0	1
Motherboard	1	2
Motherboard	2	3
Motherboard	3	4
Motherboard	4	5
Motherboard	5	6
Motherboard	6	7
Motherboard	7	8
Motherboard	8	9
Motherboard	9	10
Motherboard	10	11
Motherboard	11	12
Motherboard	12	13
Motherboard	13	14
Motherboard	14	15
Motherboard	15	16
Daughterboard	0	17
Daughterboard	1	18
Daughterboard	2	19
Daughterboard	3	20
Daughterboard	4	21
Daughterboard	5	22
Daughterboard	6	23
Daughterboard	7	24

Disconnect supervision

The line-side T1 card supports far end disconnect supervision by opening the tip side toward the terminal equipment upon the Meridian 1 system's detecting a disconnect signal from the far end on an established call. The X11 software release 21 Supervised Analog Line Feature (SAL) must be configured in overlay 10 for each line-side T1 port. At the prompt FTR respond **OSP <CR>**, and against FTR respond **ISP <CR>**. The line-side T1 card treats OSP and ISP for both originating and terminating calls as hook flash disconnect supervision, also known as cut-off disconnect. Originating calls are outgoing from the terminal equipment. Terminating calls are incoming to the terminal equipment. The line-side T1 card does not support battery reversal answer and disconnect supervision on originating calls.

After you have configured the software, you are ready to power up the card and verify the self test results. The **STATUS** LED on the faceplate indicates whether or not the line-side T1 card has successfully passed its self test, and therefore is functional. When the card is installed, this LED remains lit for two to five seconds as the self-test runs. If the self-test completes successfully, the LED flashes three times and remains lit until the card is configured and enabled in software, when the LED goes out. The LED will go out if either the motherboard or daughterboard is enabled by the software. If the LED does not follow the pattern described or operates in any other manner (such as continually flashing or remaining weakly lit), the card should be replaced.

Man-Machine T1 maintenance interface software

Description

The Man-Machine Interface (MMI) supplies a maintenance interface to a terminal providing T1 link diagnostics and historical information. See the [“Installation and Configuration” on page 87](#) for instructions on how to install the cabling and configure the terminal for the MMI. This section describes the features of MMI and explains how to set-up, configure and use the MMI firmware.

The MMI provides the following maintenance features:

- Comes equipped with default and reconfigurable alarm parameters
- Notification of T1 link problems by activating alarms
- Reports on current and historical T1 link performance
- T1 tests for T1 verification and fault isolation to line-side T1 card, T1 link, or CPE equipment

Alarms

MMI activates alarms for the following T1 link conditions: excessive bit error rate, frame slip errors, out of frame condition, loss of signal condition, and blue alarm condition. The alarms are activated in response to pre-set thresholds and error durations. Descriptions of each of these T1 link alarm conditions, instructions on how to set alarm parameters and access alarm reporting can be found in [“Alarm operation and reporting” on page 118](#).

Two levels of alarm severity exist for bit errors and frame slip errors. For these conditions, two different threshold and duration settings are established. When the first level of severity is reached (alarm level 1), the MMI will cause the external alarm hardware to activate, light the appropriate LED on the faceplate (either RED ALARM or YELLOW ALARM), display an alarm message on the MMI terminal and an create entry in the alarm log. When the second level of severity is reached (alarm level 2), the MMI will perform all of the same functions as alarm level 1 performed, and in addition, force the line-side T1 card to enter trunk processing mode. In this mode, the terminal equipment will be sent either “on-hook” or “off-hook” signals for all 24 ports to the Meridian 1, depending on how the dip switch for trunk processing was set (dip switch #2, position #6).

If the MMI detects T1 link failures for any of the remainder of the conditions monitored (out of frame condition, loss of signal condition, and blue alarm condition), the line-side T1 card automatically performs all alarm level 2 functions. The MMI also sends a yellow alarm to the distant end CPE or CSU.

Alarms can be set up to either self-clear or not self-clear when the alarm condition is no longer detected. All alarms activated produce a record in an alarm log. The alarm log maintains records for the most recent 100 alarms and can be displayed, printed and cleared. The alarm log displays or prints the alarms listing the most recent first in descending chronological order. The alarms are stamped with the date and time they occurred.

T1 Performance Counters and Reports

The MMI maintains performance error counters for the following T1 conditions: errored seconds, bursty seconds, unavailable seconds, framer slip seconds, and loss of frame seconds. It retains the T1 performance statistics for the current hour, and for each hour for the previous 24 hours. Descriptions of each of these performance error counters, and instructions on how to report on them and clear them can be found in [“Performance counters and reporting” on page 121.](#)

T1 Verification and Fault Isolation Testing

The MMI allows you to perform various tests to verify that the T1 is working adequately, or will help you to isolate a problem to either the line-side T1 card, the T1 link, or the CPE equipment. Descriptions of all of these tests and instructions on how to run them can be found in [“Testing” on page 123.](#)

Login and Password

The MMI can be accessed through any TTY, a PC running a terminal emulation program, or a modem. After installing the MMI terminal and card cables, you are ready to access the MMI firmware. For single card installations, it is accessed by entering **L<CR>** to login. For multiple card installations connected in a daisy-chain, it is accessed by entering **L <address>**, where the four-digit address is the two-digit address of the IPE shelf as set by dip switch positions (dip switch #1, positions 3-6) on the card (as opposed to the address set in the Meridian 1 software), plus the two-digit address of the card slot that the motherboard occupies. For example, to login to a card located in shelf 13, card slot 4, you would type **L 13 4 <CR>**. A space is inserted between the login command (L), the shelf address, and the card slot address

The MMI will now prompt you for a password. The password is “**LTILINK**”, and it must be typed in all capital letters.

After you have logged in, the prompt will then look like this:

- **LTi:::>** for single-card installations
- **LTi:ss cc>** for multi-card installations, where ss represents the two-digit address, and cc represents the two-digit card slot address

Basic commands

You can now execute MMI commands. There are seven basic commands that can be combined together to form a total of 19 command sets. The seven basic commands are:

- Alarm
- Clear
- Display
- Set
- Test
- Help
- Quit

If you type **?<CR>**, the MMI will list these commands along with an explanation of their usage. A screen similar to the following will appear (the help screen will also appear by typing **H<CR>**, or **HELP<CR>**):

```
ALARM  USAGE: Alarm [Enable | Disable]
CLEAR  USAGE: Clear [Alarm] | [Error counter] [Log]
DISPLAY USAGE: Display [Alarm | Status | Perform | History] [Pause]
HELP   USAGE: Help | ?
SET     USAGE: Set [Time | Date | Alarm | Clearing | Name | Memory]
TEST    USAGE: Test [Carrier All]
QUIT    USAGE: Quit
```

Notation Used:

CAPS - Required Letters [] - Optional | - Either/Or

Each of these commands can be executed by entering the first letter of the command or by entering the entire command. Command sets are entered by entering the first letter of the first command, a space, and the first letter of the second command or by entering the entire commands. [Table 27](#) shows all the possible command sets, listed in alphabetical order. These commands are also described by subject later in this section.

Table 27
MMI commands and command sets

Command	Description
A D	Alarm Disable. Disables all alarms.
A E	Alarm Enable. Enables all alarms.
C A	Clear Alarm. Clears all alarms, terminates line processing, and resets the T1 bit error rate and frame slip counters.
C A L	Clear Alarm Log. Clears the alarm log.
C E	Clear Error. Clears the error counter for the T1.
D A [P]	Display Alarms [Pause]. Displays the alarm log (a list of the most recent 100 alarms along with time and date stamps).
D C	Display Configuration. Displays the configuration settings for the cards including the serial number of the card, MMI firmware version, date and time, alarm enable/disable setting, self-clearing enable/disable setting, settings entered in Set Configuration, and dip switch settings.
D H [P]	Display History [Pause]. Displays performance counters for the past 24 hours.
D P	Display Performance. Displays performance counters for the current hour.
D S [P]	Display Status [Pause]. Displays carrier status, including whether the card is in the alarm state, and what alarm level is currently active.
H or ?	Help. Displays the help screen.
L	Login. Logs into the MMI terminal when the system has one line-side T1 card.
Q	Quit. Logs the terminal user out. If multiple line-side T1 cards share a single terminal, you should logout after using the MMI. Because of the shared daisy-chained link, if a line-side T1 card is logged in, it occupies the bus and no other line-side T1 cards are able to notify the MMI of alarms.
S A	Set Alarm parameters. Alarm parameters include the allowable bit errors per second threshold and alarm duration.
S C	Set Clearing. Sets the alarm self-clearing function to either <i>enable</i> or <i>disable</i> .
S D	Set Date. Sets date or verifies current date.
S T	Set time. Sets time or verifies current time.
T x	Test. Initiates the T1 carrier test function. To terminate a test in process, enter the STOP TEST (S) command at any time.

Configuring parameters

The MMI has been designed with default settings so that no configuration is necessary. However, you may want to reconfigure it based on your own environment.

Set Time

Before you begin to configure your MMI, login to the system and enter the current time. Do this by typing in the Set Time (S T) command set. The MMI will then display the time it has registered. You can enter a new time or just hit “Enter” to leave it unchanged. The time is entered in the “hh:mm:ss” military time format.

Set Date

You also need to set the current date. Do this by typing in the Set Date (S D) command set. MMI will then display the date it has registered. You can enter a new date or just hit “Enter” to leave it unchanged. The date is entered in the “mm/dd/yy” format.

Alarm parameters

The Set Alarm (S A) command set establishes the parameters by which an alarm is activated, and its duration. There are three alarm activation levels as described below:

- **Alarm Level 0 (AL0)** consists of activity with an error threshold below the AL1 setting. This is deemed to be a satisfactory condition and therefore no alarm will be activated.
- **Alarm Level 1 (AL1)** consists of activity with an error threshold above the AL1 setting but below AL2 setting. This is deemed to be a minor unsatisfactory condition. In this situation, the external alarm hardware will be activated by closing the normally open contact, the RED ALARM LED on the faceplate will light, and an alarm message will be created in the alarm log and the MMI terminal.

- **Alarm Level 2 (AL2)** consists of activity with an error threshold above the AL2 setting. This is deemed to be an unsatisfactory condition. In this situation, the external alarm hardware will be activated by closing the normally open contact, the RED ALARM LED on the faceplate will light, an alarm message will be created in the alarm log and the MMI terminal, the line-side T1 card will enter line processing mode, and a yellow alarm message will be sent to the CPE/CSU. Line processing will send the Meridian 1 either all “on-hook” or all “off-hook” signals, depending on the dip switch setting of the card.

When you use the Set Alarm command, you will be prompted to set the threshold level and duration period for alarm levels 1 and 2.

The threshold value indicates the number of bit errors detected per second that is necessary to activate the alarm. The T1 link processes at a rate of approximately 1.5 mb/s. The threshold value can be set between 3 and 9 and can be different for each alarm level. Any other value entered will cause the software to display a “Parameter Invalid” message. The threshold number that you enter represents the respective power of 10 as shown in [Table 28](#).

Note: The error rate threshold for a level 2 alarm must be greater (a smaller power of 10) than for a level 1 alarm.

Table 28
T1 bit error rate threshold settings

Alarm Threshold bit errors per second in Power of 10	Threshold to set alarm	Allowable Duration Periods
10^{-3}	1,500/second	1–21 seconds
10^{-4}	150/second	1–218 seconds
10^{-5}	15/second	1–2148 seconds
10^{-6}	1.5/second	1–3600 seconds
10^{-7}	1.5/10 seconds	10–3600 seconds
10^{-8}	1.5/100 seconds	100–3600 seconds
10^{-9}	1.5/1000 seconds	1000–3600 seconds

The duration value is set in seconds and can be set from 1 to 3,600 seconds (1 hour). This duration value indicates how long the alarm will last. Low bit error rates (10^{-7} through 10^{-9}) are restricted to longer durations since it takes more than one second to detect an alarm condition above 10^{-6} . Higher bit error rates are restricted to shorter durations because the MMI error counter fills at 65,000 errors.

The alarm indications (LEDs and external alarm contacts) will clear automatically after the duration period has expired if the Set Clearing (S C) "Enable Self Clearing" option has been set. Otherwise, the alarm will continue until the command set Clear Alarm (C A) has been entered. When an alarm is cleared, all activity caused by the alarm will be cleared: the external alarm hardware will be deactivated (the contact normally open will be reopened), the LED light will go out, an entry will be made in the alarm log of the date and time the alarm was cleared, and carrier fail line supervision will cease (for alarm level 2 only). If self-clearing alarm indications have been disabled, carrier fail line supervision will terminate when the alarm condition has ceased, but the alarm contact and faceplate LED will remain active until the alarm is cleared.

Note: Note: A heavy bit error rate can cause 150 bit errors to occur in less than 100 seconds. This will cause the alarm to be declared sooner.

An alarm will not be automatically cleared until the system no longer detects the respective bit error threshold during the corresponding duration period. For example, if an AL1 threshold of 6 (representing 10^{-6}) and a duration period of 100 seconds is specified, an alarm will be activated if more than 150 bit errors occur in any 100 second period ($1.5 \text{ seconds} \times 100 \text{ seconds} = 150/100 \text{ seconds}$). As soon as the alarm is activated, the bit counter is reset to 0. If the next 100 seconds pass, and less than 150 bit errors are detected, then the alarm will clear after the duration period. However, if more than 150 bit errors are detected in the next 100 seconds, the alarm continues for the designated duration period. The alarm will finally clear when the alarm condition is no longer detected for the designated duration period either by self-clearing (if this function is enabled), or when the Clear Alarm (C A) command set is entered.

In addition to bit errors, the Set Alarm function sets parameters for detecting frame slip errors by establishing a threshold necessary to activate an alarm. If the threshold value is exceeded, a level 2 alarm will be activated. The frame slip threshold can be specified from 1 to 255 frame slips per time period. The duration time period can be specified from 1 to 24 hours.

When entering the Set Alarm command set, the MMI will scroll through the previously described series of alarm options. These options are displayed along with their current value, and you can either enter a new value or hit enter to retain the current value. [Table 29](#) outlines the options available in the Set Alarm function.

Table 29
Set alarm options

Option	Description
AL1 Threshold	Sets the allowable bit errors per second (from 3 to 9) before alarm level 1 is activated. Factory default is 10^{-6} .
AL1 Duration	Sets the duration in seconds (from 1 to 3,600 seconds) that alarm level 1 is activated. Factory default is 10 seconds.
AL2 Threshold	Sets the allowable bit errors per second (from 3 to 9) before alarm level 2 is activated. Factory default is 10^{-5} .
AL2 Duration	Sets the duration in seconds (from 1 to 3,600 seconds) that alarm level 2 is activated. Factory default is 10 seconds
Frame Slip Threshold	Sets the allowable frame slips per time period (from 1 to 255) before alarm level 2 is activated. Factory default is 5.
Frame Slip Duration	Sets the duration in hours (from 1 to 24) that the frame slips are counted. After this time period, the counter is reset to 0. Factory default is 2 hours.

Note: If the duration period is set too long, the line-side T1 card will be slow to return to service automatically even when the carrier is no longer experiencing any errors. The Clear Alarm command will have to be entered manually to restore service promptly. To avoid this, the duration period should normally be set to 10 seconds.

Set Clearing

The Set Clearing (S C) command set allows you to enable or disable self-clearing of alarms by answering **Y** or **N** to the question: “Enable Self Clearing? (YES or NO)”. If “Enable Self-Clearing” is chosen (the factory default condition), the system will automatically clear alarms after the alarm condition is no longer detected for the corresponding duration period. The “Disable Self-Clearing” option causes the system to continue the alarm condition until the Clear Alarm (C A) command set is entered. Line processing and the yellow alarm indication to the CPE is terminated as soon as the alarm condition clears, even if “Disable Self-Clearing” is set.

Display Configuration

The Display Configuration (D C) command set displays the various configuration settings established for the line-side T1 card. Entering the Display Configuration (D C) command set will cause a screen similar to the following to appear:

```
LTI S/N 1103 Software Version 1.01   3/03/95 1:50
Alarms Enabled: YES   Self Clearing Enabled: YES
Alarm Level 1 threshold value: E-7   Threshold duration (in seconds): 10
Alarm Level 2 threshold value: E-5   Threshold duration (in seconds): 1
Frame slips alarm level threshold: 5   Threshold duration (in hours): 2
Current dip switch S1 settings (S1..S8) On Off Off On Off Off Off On
Current dip switch S2 settings (S1..S8) On Off On Off Off Off On Off
```

Alarm operation and reporting

The MMI monitors the T1 link according to the parameters established through the Set Alarm command set for the following conditions:

- Excessive bit error rate
- Frame slip errors
- Out of frame condition
- Loss of signal condition
- Blue alarm (AIS) condition

Descriptions of the excessive bit error rate and frame slip errors conditions can be found in [“Configuring parameters” on page 114](#). Bit errors may activate either a level 1 or level 2 alarm. The remaining conditions, when detected, will always cause the system to activate a level 2 alarm.

An out of frame condition will be declared if two out of four frame bits are in error. If this condition occurs, the hardware will immediately attempt to reframe. During the reframe time, the T1 link will be declared out of frame, and silence will be sent on all receive timeslots.

A loss of signal condition is declared if a full frame (192 bits) of consecutive zeros has been detected at the receive inputs. If this condition occurs, the T1 link will automatically attempt to resynchronize with the distant end. If this condition occurs for more than two seconds, a level 2 alarm will be declared, and silence will be sent on all receive timeslots. The alarm will be cleared if, after two seconds, neither a loss of signal, out of frame condition, nor blue alarm condition occurs.

If a repeating device loses signal, it will immediately begin sending an unframed all ones signal to the distant end to indicate an alarm condition. This condition is called a blue alarm, or an alarm indication signal (AIS). If an AIS is detected for more than two seconds, a level 2 alarm will be declared, and silence will be sent on all receive timeslots. The alarm will be cleared if, after two seconds, neither a loss of signal, out of frame condition, nor blue alarm condition occurs.

Alarm Disable

The Alarm Disable (A D) command disables the external alarm contacts. When this command is typed in the MMI will display the message “Alarms Disabled” and the MAINT LED will light. In this mode, no yellow alarms are sent and the line-side T1 card will not enter line processing mode. Alarm messages will still be to be sent on the MMI terminal and the LED light will still continue to indicate alarm conditions.

Alarm Enable

The Alarm Enable (A E) command set does the reverse of the Alarm Disable command set. It enables the external alarm contacts. When this command set is typed in, the MMI will display the message “Alarms Enabled.” In this mode, yellow alarms can be sent and the line-side T1 card can enter line processing mode.

Clear Alarm

The Clear Alarm (C A) command set will clear all activity initiated by an alarm: the external alarm hardware will be deactivated (the contact normally open will be reopened), the LED light will go out, an entry will be made in the alarm log of the date and time the alarm was cleared, and line processing will cease (for alarm level 2 only). When this command set is typed in, the MMI will display the message "Alarm acknowledged." If the alarm condition still exists, the alarm will be declared again.

Display Alarms

A detailed report of the most recent 100 alarms with time and date stamps can be displayed by entering the Display Alarms (D A) command set into the MMI. Entering the Display Alarms (D A) command set will cause a screen similar to the following to appear:

Alarm Log

3/03/95 1:48 Yellow alarm on T1 carrier

3/03/95 1:50 Initialized Memory

3/03/95 2:33 T1 carrier level 1 alarm

3/03/95 3:47 T1 carrier level 2 alarm

3/03/95 4:43 T1 carrier performance within thresholds

3/03/95 15:01 Log Cleared

The Pause command can be used to display a full screen at a time by entering D A P.

Clear Alarm Log

You can clear all entries in the alarm log by typing in the Clear Alarm Log (C A L) command set.

Display Status

The Display Status (D S) command set displays the current alarm condition of the T1 link as well as the on-hook or off-hook status of each of the 24 ports of the line-side T1 card. Entering the Display Status (D S) command set will cause a screen similar to the following to appear:

LT1 S/N Software Version 1.01 3/03/95 1:50

In alarm state: NO

T1 link at alarm level 0

Port 0 off hook, Port 1 on hook, Port 2 on hook, Port 3 on hook,

Port 4 on hook, Port 5 on hook, Port 6 off hook, Port 7 off hook,

Port 8 off hook, Port 9 on hook, Port 10 on hook, Port 11 on hook,

Port 12 off hook, Port 13 on hook, Port 14 on hook, Port 15 on hook,

Port 16 on hook, Port 17 on hook, Port 18 off hook, Port 19 off hook,

Port 20 off hook, Port 21 on hook, Port 22 on hook, Port 23 on hook

Performance counters and reporting

The MMI monitors the performance of the T1 link according to several performance criteria including errored, bursty, unavailable, loss of frame and frame slip seconds. It registers the performance of these criteria by reading their status every second and counting their results. These counts are accumulated for an hour, at which time they are reset to 0. Previous hour count results are maintained for each hours for the previous 24 hours.

The performance criteria for which these counts are maintained are as follows:

- Errored seconds—one or more CRC-6 errors, or one or more out of frame errors in a second
- Bursty seconds—more than one and less than 320 CRC-6 errors in a second
- Unavailable seconds—unavailable state starts with 10 consecutive severely errored seconds and ends with 10 consecutive severely errored seconds (excluding the final 10 non-severely errored seconds). Severely errored seconds are defined as more than 320 CRC-6 errors, or one or more out of frames in a second

- Loss of frame seconds—loss of frame or loss of signal for three consecutive seconds
- Framer slip seconds—one ore more frame slips in a second

The MMI also maintains an overall error counter that is just a sum of all the errors counted for the five performance criteria listed above. The error counter can only be cleared by entering the “Clear Error” command. It will stop counting at 65,000. The error counter provides an easy method to determine if an alarm condition has been corrected. Simply clear the error counter, wait a few minutes, and display performance to see if any errors have occurred since the counter was cleared.

Reports on these performance counters can be displayed by entering the Display Performance (D P) or the Display History (D H) command sets into the MMI.

Display Performance

Entering the Display Performance (D P) command set will display performance counters for the past hour. A screen similar to the following will appear:

LTI T1 Interface Performance Log
3/03/95 1:37

Data for the past 37 Minutes

Errored	Bursty	Unavailable	Loss Frame	Frame Slip	Error
Seconds	Seconds	Seconds	Seconds	Seconds	Counter
2263	0	2263	2263	352	321

Each column, except the error counter, indicates the number of errors in the current hour and is reset to zero every hour on the hour. When these counters are reset to zero, the performance counter values are put into the history log. The error counter indicates the number of errors since the error counter was cleared.

Display History

Entering the Display History (D H) command set will display performance counters for each hour for the past 24 hours. A screen similar to the following will appear:

LTI T1 Interface History Performance Log						
3/03/95 1:35						
Hour Ending	Errored Seconds	Bursty Seconds	Unavailable Seconds	Loss Frame Seconds	Frame Slip Seconds	Error Counter
20:00	139	0	129	139	23	162
19:00	0	0	0	0	0	0
18:00	0	0	0	0	0	0
17:00	0	0	0	0	0	0
16:00	0	0	0	0	0	0

The pause command can be used to display a full screen at a time by entering D H P.

Clear Error

You can reset the error counter to zero by entering the Clear Error (C E) command set. The error counter provides a convenient way to determine if the T1 link is performing without errors since it can be cleared and examined at any time.

Testing

The Test Carrier (T C) command set allows you to run tests on the line-side T1 card, the T1 link, or the CPE device. The three tests give you the capability to isolate faulty conditions to any one of these three sources. See [Table 30](#) for additional information on these three test types. After entering the T C command set, you will be prompted to enter which of the three tests you wish to initiate. The prompt will appear similar to the following:

```
Test 1: Local Loopback Test
Test 2: External Loopback Test
Test 3: Network Loopback Test
(1,2,3 or S to cancel):
```

Tests can be performed once (for 1 through 98 minutes), or continuously (selected by entering 99 minutes) until a “Stop Test” command is entered. Tests continue for the duration specified even if a failure occurs, and terminate at the end of the time period or when a “Stop Test” command is issued. Only a “Stop Test” command will stop a test with a duration selection of 99. After entering the test number selection, a prompt similar to the following will appear:

Enter Duration of Test (1-98 Mins, 0 = Once, 99 = Forever)

Verify DS-30A Links are disabled. Hit Q to quit or any Key to Continue

Before a test is run, be sure to verify that DS-30A links are disabled since the tests will interfere with calls currently in process.

During a test, if an invalid word is received, a failure peg counter is incremented. The peg counter saturates at 65,000 counts. At the end of the test, the Test Results message will indicate how many failures, if any, occurred during the test.

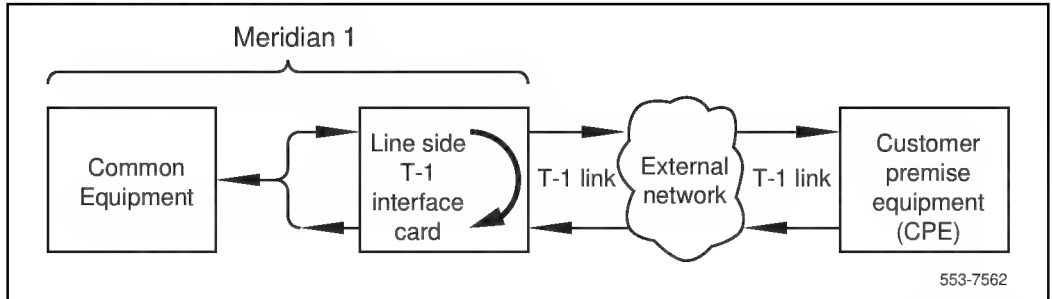
[Table 30](#) shows which test to run for the associated equipment.

Table 30
MMI Tests

Test Number	Equipment Tested	Test Description
1	line-side T1 card	Local loopback
2	T1 link, line-side T1 card and T1 network	External loopback
3	CPE device and T1 network	Network loopback

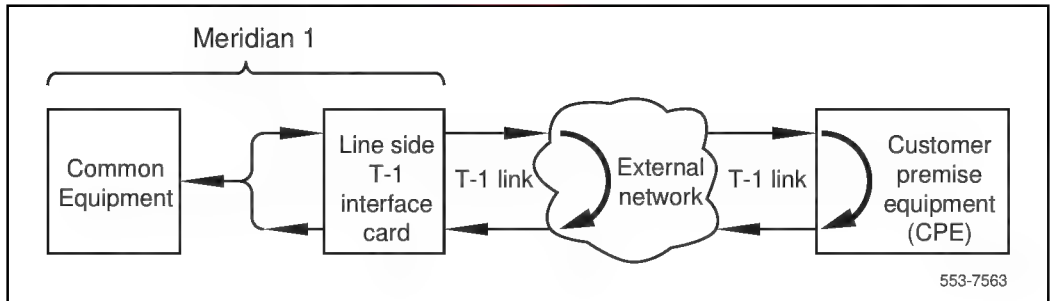
Test 1, local loopback, loops the T1 link signaling toward itself at the backplane connector, and test data is generated and received on all timeslots. If this test fails, it indicates that the line-side T1 card is defective. [Figure 26](#) demonstrates how the signaling is looped back toward itself.

Figure 26
MMI Local loopback test



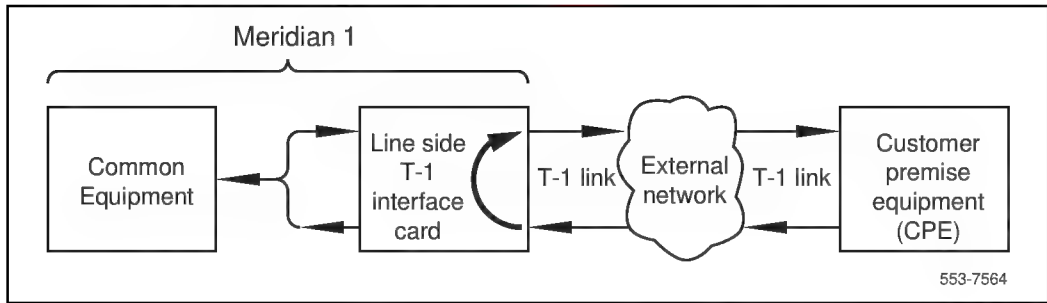
Test 2, external loopback, assumes an external loopback is applied to the T1 link. Test data is generated and received by the line-side T1 card on all timeslots. If test 1 passes but test 2 fails, it indicates that the T1 link is defective between the line-side T1 card and the external loopback location. If test 1 was not run and test 2 fails, the T1 link or the line-side T1 card could be defective. To isolate the failure to the T1 link, tests 1 and 2 must be run in tandem. [Figure 27](#) demonstrates how an external loopback is applied to the T1 link.

Figure 27
MMI External loopback test



Test 3, network loopback, loops the received T1 data back toward the CPE equipment. No test data is generated or received by the line-side T1 card. If test 2 passes but test 3 fails, it indicates that the CPE device is defective. If test 2 was not run and test 3 fails, the T1 link or the CPE device could be defective. To isolate the failure to the CPE device, tests 2 and 3 must be run in tandem. [Figure 28](#) demonstrates how the signaling is looped back toward the CPE equipment.

Figure 28
MMI Network loopback test



Applications

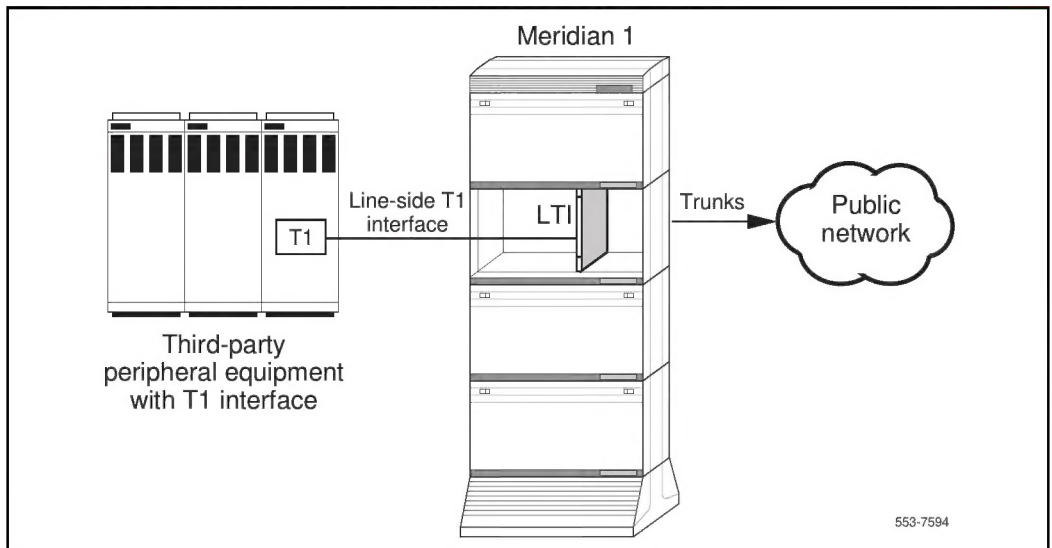
The line-side T1 interface is an Intelligent Peripheral Equipment (IPE) line card that provides cost-effective connection between T1-compatible peripheral equipment and a Meridian 1 system or off-premise extensions over long distances.

Some examples of applications where a line-side T1 card can be interfaced to a T1 link are:

- T1 compatible voice response unit (VRU) equipment
- T1 compatible turret systems
- T1 compatible wireless systems
- Remote 2500 sets through T1 to a channel bank
- Remote Norstar sites behind Meridian 1 over T1

The line-side T1 card is appropriate for any application where both T1 connectivity and “line-side” functionality is required. This includes connections to T1-compatible voice response units, voice messaging and trading turret (used in stock market applications) systems (see [Figure 29](#)).

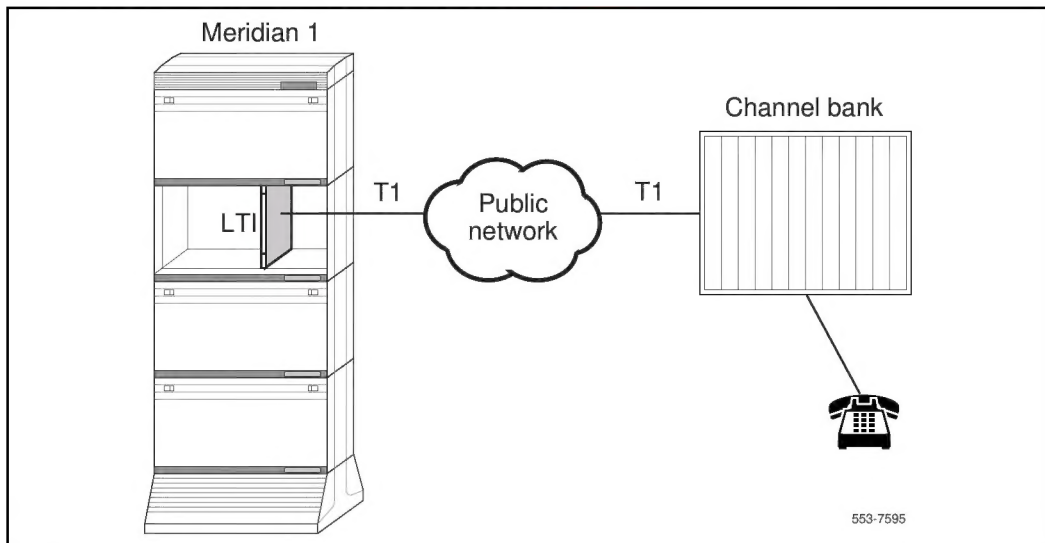
Figure 29
Line-side T1 interface connection to peripheral equipment



For example, the line-side T1 card can be used to connect the Meridian 1 to a T1-compatible voice response unit (VRU). An example of this type of equipment is Nortel Open IVR system. In this way, the Meridian 1 can send a call to the VRU, and, because the line-side T1 card supports 2500-type functionality, the VRU is able to send the call back to the Meridian 1 for further handling.

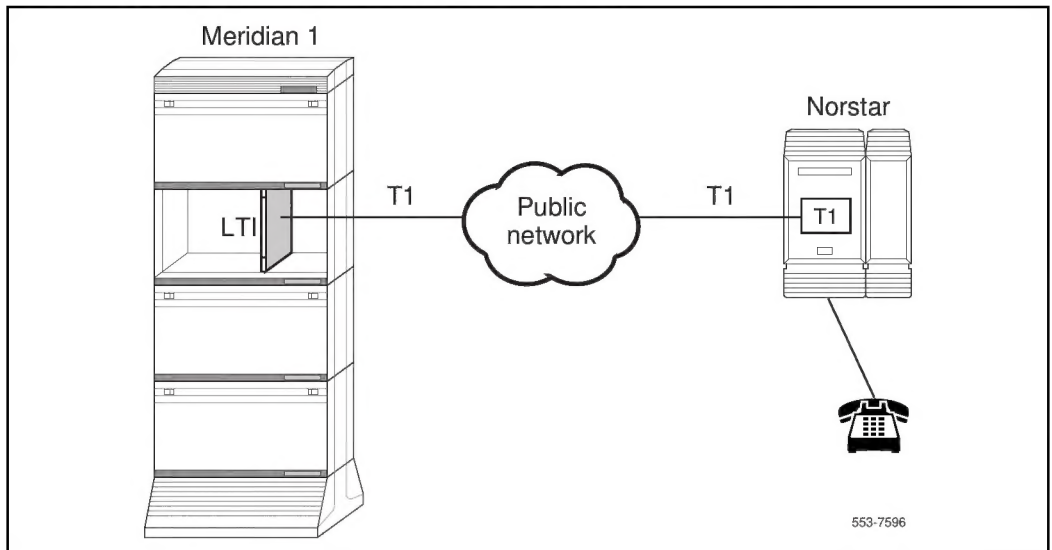
The line-side T1 card can also be used to provide off-premise extensions to remote locations (up to 500 miles from the Meridian 1 system). In this application, the analog telephone functionality is extended over T1 facilities, providing a telephone at a remote site with access to 2500-type line functionality ([Figure 30](#)). An audible message waiting indicator can be provided as well.

Figure 30
Line-side T1 interface in off-premise application



Similarly, the line-side T1 can be used to provide a connection between the Meridian 1 system and a remote Norstar system (. In this case, channel banks would not be required provided that the Norstar system is equipped with a T1 interface.

Figure 31
Line-side T1 interface connection to Norstar system



Note: The line-side T1 card audio levels must be considered when determining the appropriateness of an application.

